

Development of a new time of flight particle telescope for ion mass composition of solar energetic particles

Completed Technology Project (2018 - 2021)



Project Introduction

Scientists and engineers from The Aerospace Corporation propose to develop a new time of flight by energy mass spectrometer using a new technology: carbon solid state detectors (diamond detectors). The proposed research project will further test a new instrument concept using diamond detectors in a time of flight by energy mass spectrometer. Diamond detectors are a relatively new technology, and they have many benefits over the standard silicon and germanium solid state detectors. Diamond detectors have significantly higher radiation tolerance compared to silicon and germanium detectors, and critical to this proposed project, diamond detectors have much faster response times, on the order of 10 ps (1e-11 seconds). When combined with commercially available ultra-fast preamplifiers and electronics, we have already demonstrated in the lab that two of these detectors can be used to measure the time of flight and energy deposit of >10 MeV heavy ions over a detector separation distance of < 10 cm. Those lab tests served as a proof-of-concept of the successful functionality of the critical components of the new instrument, which raised the technology readiness level (TRL) of this concept to TRL-3. We are proposing to continue development of this new instrument concept and design and develop a prototype instrument that will be tested in a relevant lab environment, raising the TRL to TRL-6. If successful, the proposed development will render this instrument ready for inclusion on proposed missions of opportunity. The prototype instrument will be designed with efficiency in mind, with our goal being an instrument with size, weight, and power specifications that will allow it to be flight-tested on a future CubeSat mission. The instrument design will benefit from Aerospace's decades-long participation and leadership in energetic particle telescope design; it will incorporate the state-of-the-art electronics and materials technology that Aerospace has developed over its well-established history developing instruments for energetic particle detection. Furthermore, we will take full advantage of Aerospace's long-standing partnership with the Lawrence Berkeley National Lab 88-inch cyclotron facility, where we will test the performance of the instrument at discriminating the mass and measuring the energy of a cocktail of different >10 MeV ions (including protons). This project has the potential to provide an entirely new type of instrument for the detection and very high energy ions, providing a very accurate measure of the incident ion energy as well as discriminating the mass of the ions, enabling ion composition studies of energetic populations such as solar energetic particles (SEPs), trapped radiation in planetary magnetospheres, and potentially even anomalous cosmic rays. The proposed project also tests a new technology, diamond detectors, and broadens our understanding of the potential uses for this technology in the process.



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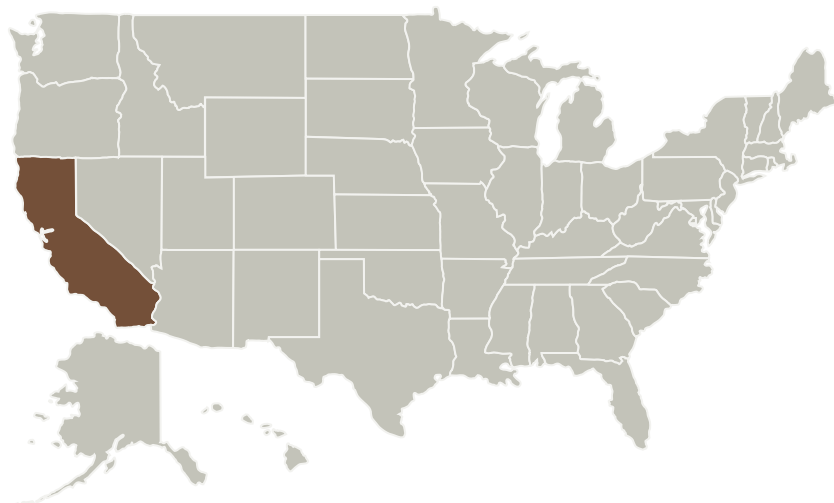
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
The Aerospace Corporation	Lead Organization	Industry	El Segundo, California

Primary U.S. Work Locations

California

Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Lead Organization:

The Aerospace Corporation

Responsible Program:

Heliophysics Technology and Instrument Development for Science

Project Management

Program Director:

Roshanak Hakimzadeh

Program Manager:

Roshanak Hakimzadeh

Principal Investigator:

Drew L Turner

Co-Investigators:

Krandalyn J Richardson
J B Blake

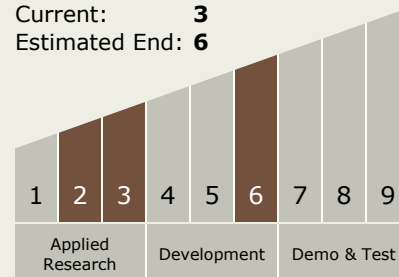
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Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **6**



Technology Areas

Primary:

- TX08 Sensors and Instruments
 - └ TX08.3 In-Situ Instruments and Sensors
 - └ TX08.3.1 Field and Particle Detectors

Target Destination

The Sun